

WHAT IS CLAIMED IS:

1. A method for manufacturing a tantalum oxy
nitride capacitor comprising:

forming a lower electrode on a surface of a
semiconductor substrate using a material selected
from the group consisting of undoped silicon, doped
silicon and mixtures thereof;

forming MPS (Metastable Poly Silicon) using
gases each containing a silicon source after
performing wet etching or dry etching of the lower
electrode;

performing MPS doping in a chamber by using a
mixed gas comprising P;

depositing a nitride film, in said chamber;

depositing a tantalum oxy nitride thin film
using a chemical vapor comprising tantalum on the
nitride film;

performing nitrating or nitrifying a surface of
the tantalum oxynitride thin film; and

forming an upper electrode by stacking a metal
layer on an upper portion of the tantalum oxy
nitride thin film.

2. The method for manufacturing a tantalum oxy
nitride capacitor according to claim 1, wherein the MPS
formation, the MPS doping, the nitride depositing and the
tantalum oxy nitride film depositing are performed in
said chamber.

3. The method for manufacturing a tantalum oxy
nitride capacitor according to claim 1, wherein the wet
etching or the dry etching of the lower electrode is
performed using a gas comprising HF.

4. The method for manufacturing a tantalum oxy
nitride capacitor according to claim 1, wherein the gas
comprising HF is selected from the group consisting of
hydrogen fluoride/water ($\text{HF}/\text{H}_2\text{O}$), hydrogen
5 fluoride/hydrogen peroxide ($\text{HF}/\text{H}_2\text{O}_2$), buffered oxide
etchant (BOE), hydrogen fluoride/acetic acid/nitrogen
dioxide ($\text{HF}/\text{CH}_3\text{COOH}/\text{NO}_2$) and mixtures thereof.

5. The method for manufacturing a tantalum oxy
10 nitride capacitor according to claim 1, wherein the gas
comprising a silicon source is used in the MPS formation
selected from the group consisting of SiH_4 , Si_2H_6 , SiH_2Cl_2
and mixtures thereof.

15 6. The method for manufacturing a tantalum oxy
nitride capacitor according to claim 1, wherein the MPS
doping is performed under a pressure ranging from about
 1.0×10^{-3} to about 500 torr and at a temperature ranging
from about 500 to about 1000°C.

20 7. The method for manufacturing a tantalum oxy
nitride capacitor according to claim 1, wherein the gas
comprising P is a mixed gas comprising PH_3 .

25 8. The method for manufacturing a tantalum oxy
nitride capacitor according to claim 7, wherein the mixed
gas comprising PH_3 is selected from the group consisting
of PH_3/N_2 , PH_3/H_2 , PH_3/SiH_4 , PH_3/Ar and mixtures thereof.

30 9. The method for manufacturing a tantalum oxy
nitride capacitor according to claim 1, wherein the
nitride depositing is performed by using NH_3 gas.

10. The method for manufacturing a tantalum oxy
nitride capacitor according to claim 9, wherein the
nitride depositing is performed under a pressure ranging
from about 0.1 to about 200 torr and at a temperature
5 ranging from about 600 to about 850°C.

11. The method for manufacturing a tantalum oxy
nitride capacitor according to claim 1, wherein the
evaporated tantalum ethylate is the chemical vapor
10 comprising tantalum.

12. The method for manufacturing a tantalum oxy
nitride capacitor according to claim 1, wherein the
tantalum oxy nitride postprocessing is performed by
15 nitrating the surface under NH_3 (or N_2/H_2) atmosphere or
nitrifying the surface under N_2O or O_2 atmosphere.

13. The method for manufacturing a tantalum oxy
nitride capacitor according to claim 1, wherein the
20 nitrating or nitrifying is performed at a temperature
ranging from about 200 to about 600°C by using a plasma.

14. The method for manufacturing a tantalum oxy
nitride capacitor according to claim 1, wherein the upper
25 electrode is formed by depositing a material selected
from the group consisting of poly silicon (Poly Si),
titanium nitride (TiN), tantalum nitride (TaN), tungsten
(W), tungsten nitride (WN), tungsten silicide (Wsi),
ruthenium (RU), ruthenium oxide (RuO_2), iridium (Ir),
30 platinum (Pt), individually or repeatedly to form a
stacking structure.

15. A semiconductor device comprising a capacitor
made in accordance with the method of claim 1.

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